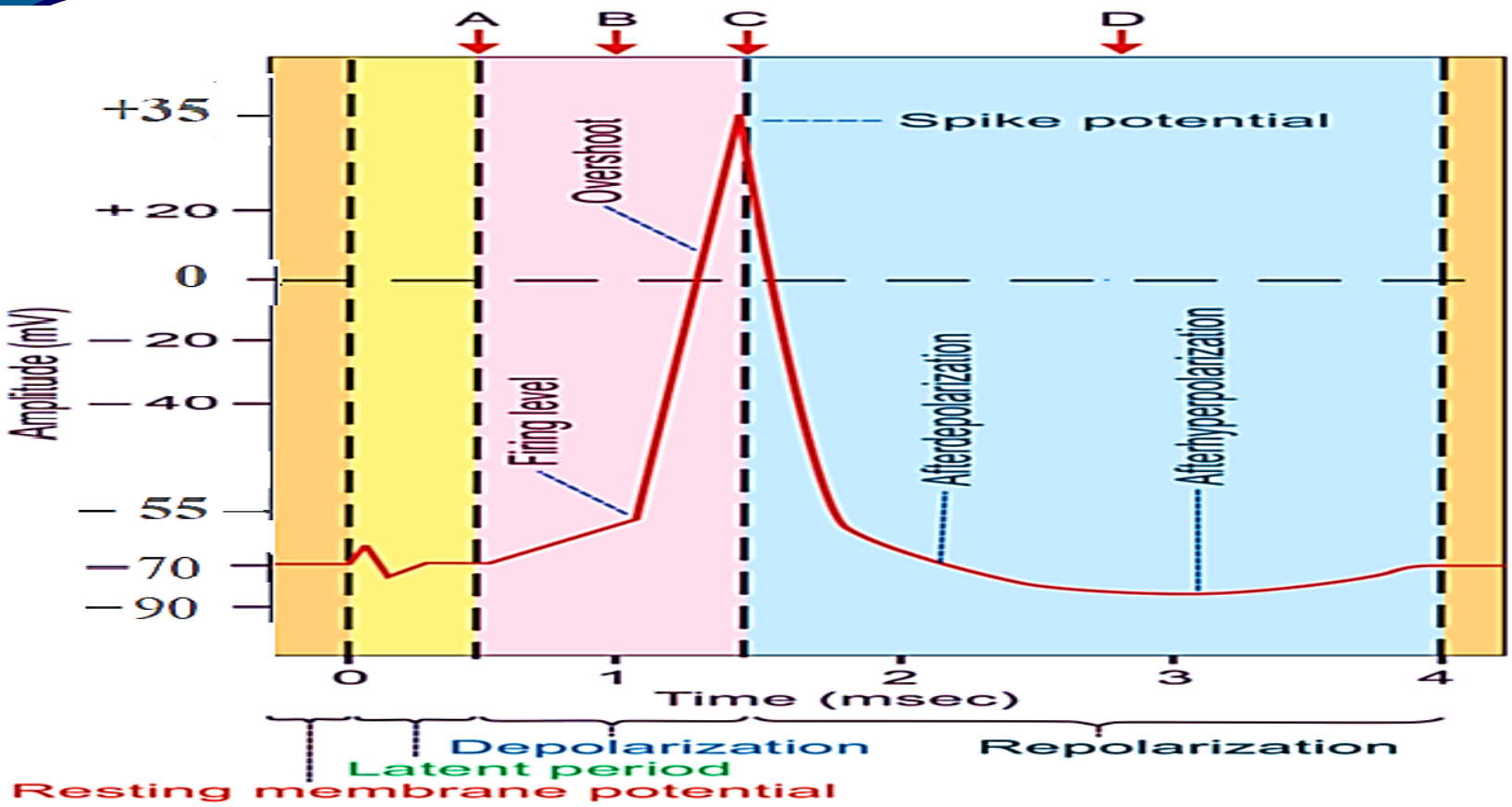
Action Potential

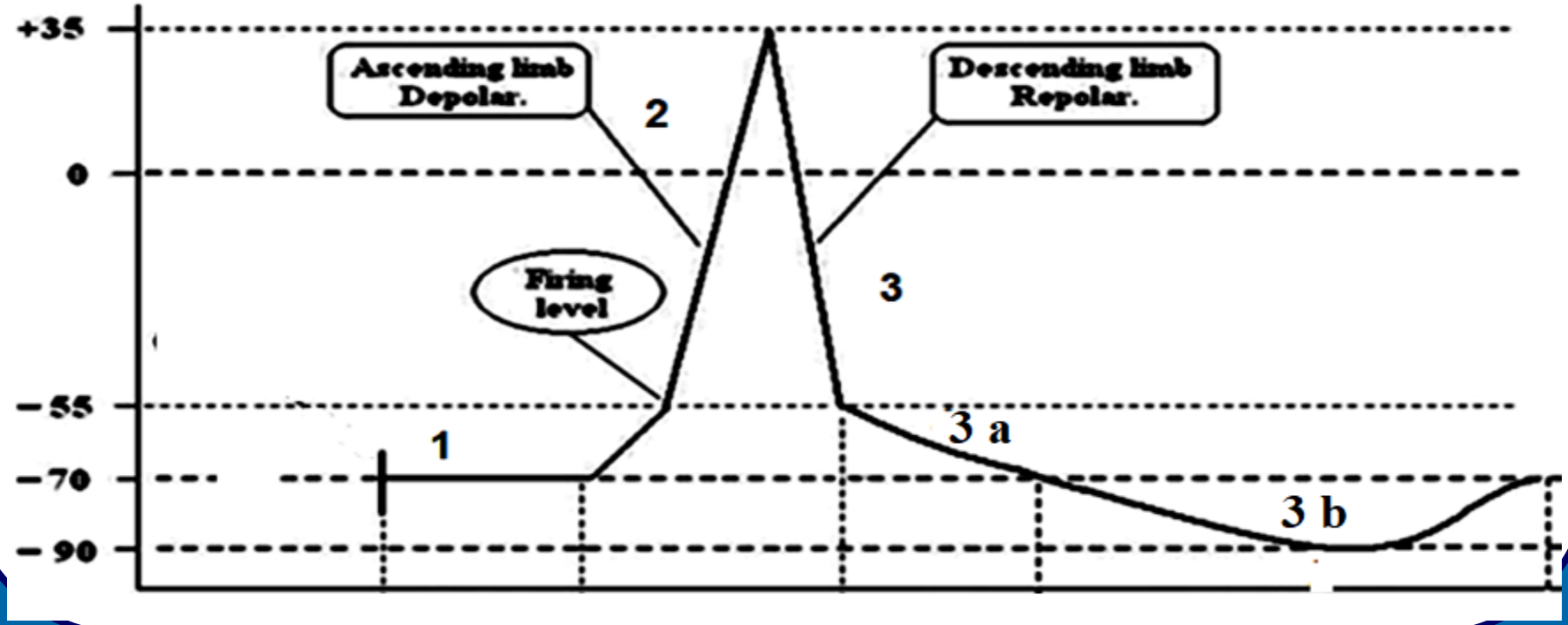


PROF . KHALED ABDEL-SATER,

The Action Potential

Stages and Ionic Bases of Action Potential

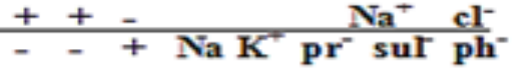
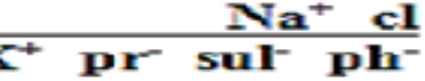
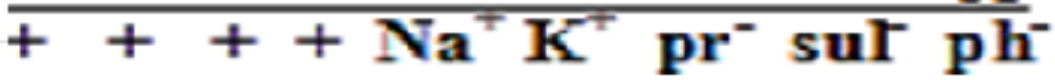
1- Latent period: ***Def.*** It is the time between application of the stimulus and the beginning of the curve.



The Action Potential

Stages and Ionic Bases of Action Potential

2- Depolarization (Ascending Limb):

From -70 mV to -55 mV	due to the opening of a few voltage-gated Na^+ channels.
At -55 (firing level)	due to the rapid opening of all voltage-gated Na^+ channels. 
At zero (isopotential = depolarization).	the potential difference between the outer and inner surface of the membrane is zero 
From zero level to +35 mV (reversal of polarity)	The inside becomes positive (due to Na^+ & K^+) and the outer negative (due to Cl^-). 

The Action Potential

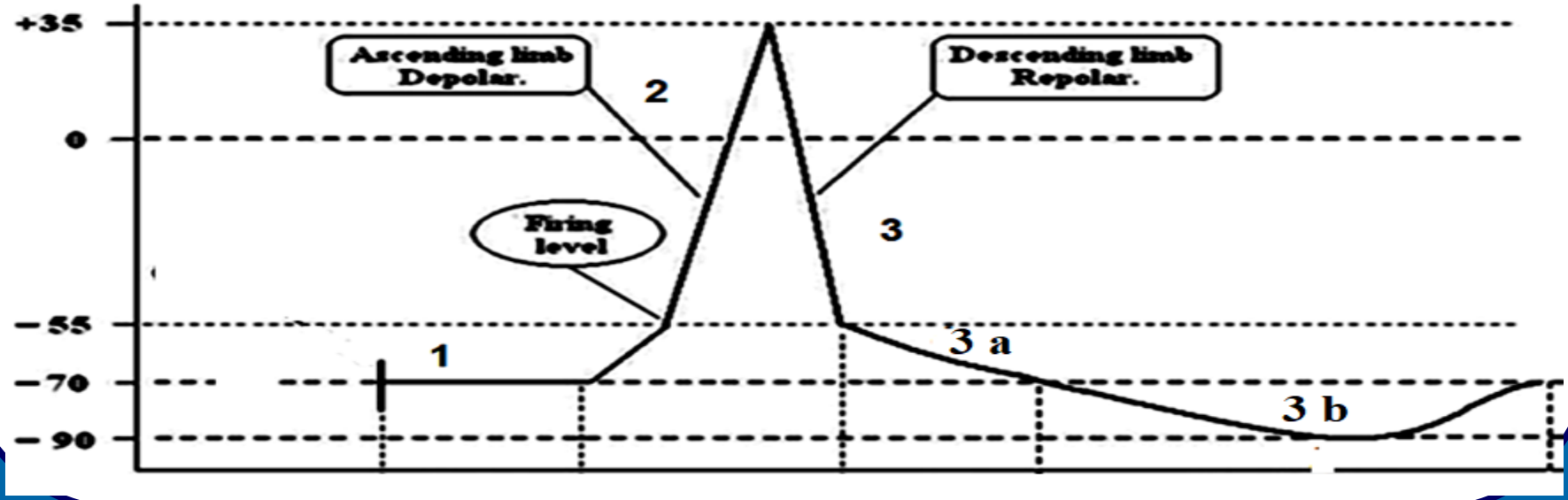
Stages and Ionic Bases of Action Potential

2- Depolarization (Ascending Limb):

Causes of Depolarization:

-Opening of fast voltage gated Na^+ channels.

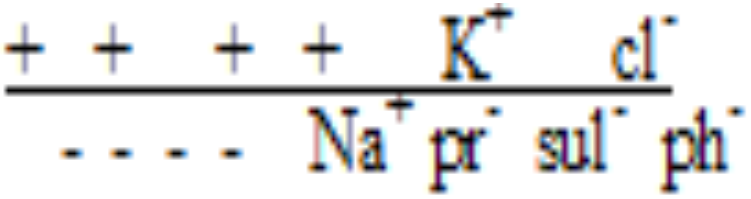
-At +35 mv Na^+ channels are closed.



3- Repolarization (Descending Limb)

A-Rapid repolarization :

70% of curve



-Rapid depolarization and rapıd repolarızatıon is called **spike potential .**

-Causes of Rapid Repolarization: Closure of Na^+ channels and increasing of K^+ outflow. The maximal opening of K^+ channels just at the same time that the Na^+ channels are closed i.e. at +35 mv.

4- Repolarization (Descending Limb)

B-After Potential: slow 30 % of the curve.

a- Negative after potential (after depolarization).

- Outer surface becomes less positive than in resting condition.

-Causes: The outward diffusion of potassium ion is decreased due to concentration and electric gradient.

b- Positive after potential (after hyperpolarization).

-Outer surface becomes more positive than in resting condition.

-Causes: Slow closure of K^+ channels.

4- Repolarization (Descending Limb)

** *The resting membrane potential is re-established again* *by* Na^+ - K^+ *pump.*

+ + + + + + Na^+ cl^-

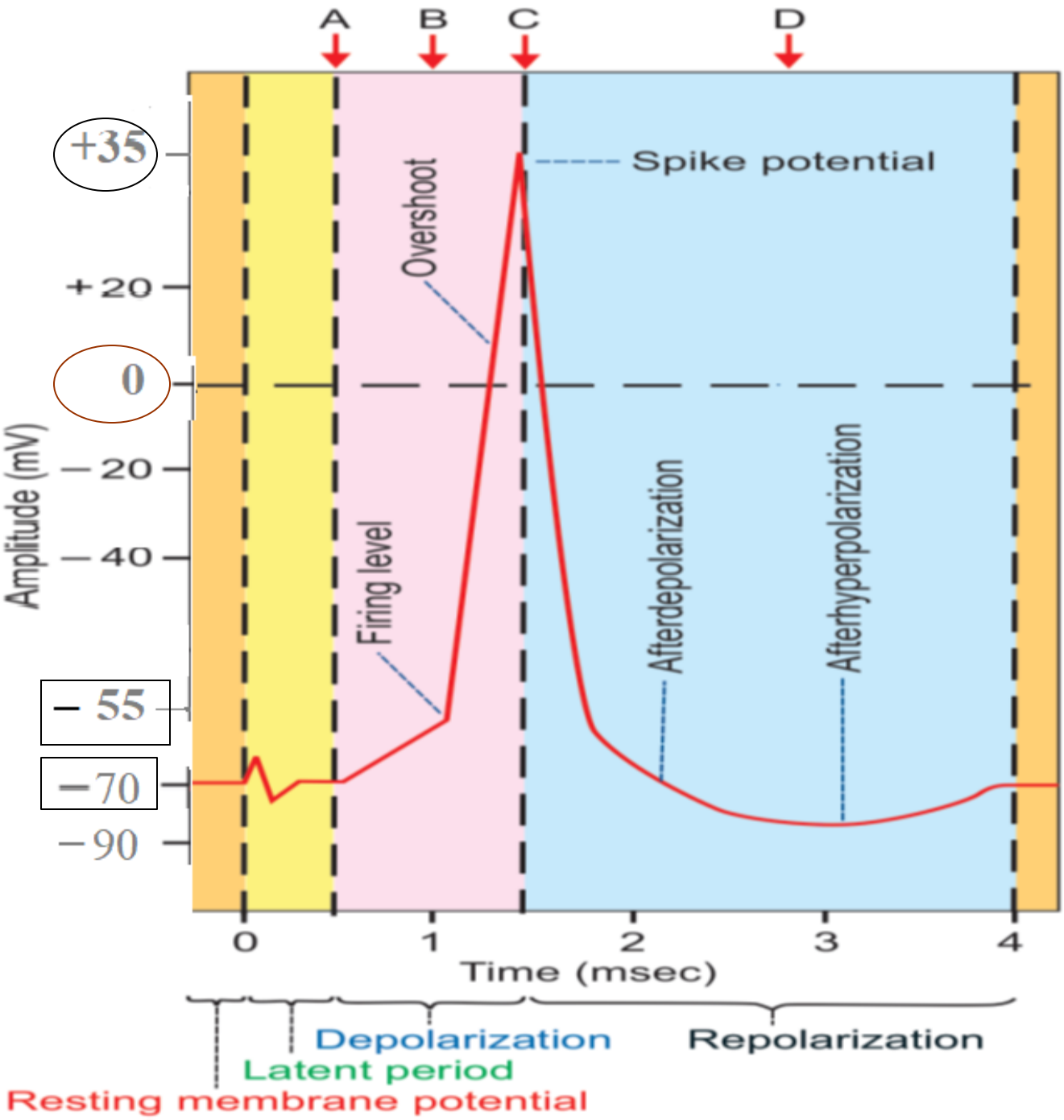
- - - - K^+ pr^- sul^- ph^-

A = Opening of few Na+ channels

B = Opening of many Na+ channels

C = Closure of Na+ channels and opening of K+ channels

D = Closure of K+ channels



Test your self

The action potential results from:

1

A. a decrease in membrane permeability for K+ ions.
B. a decrease in membrane permeability for K+ ions.
C. a large increase in membrane permeability to Na+ ions;
D. a large increase in membrane permeability to K+ ions (100 times);
E. opening of leakage channels;

Concerning the action potential phases, latent period is the time between the :

2

A. beginning of depolarization & the beginning of the repolarization.
B. beginning of repolarization & the beginning of the RMP.
C. application of the stimulus & the beginning of repolarization.
D. application of the stimulus & the beginning of depolarization.

During the ascending limb of the action potential:

3

(A) there is net outward current and the cell interior becomes more negative

(B) there is net outward current and the cell interior becomes positive

(C) there is net inward current and the cell interior becomes more negative

(D) there is net inward current and the cell interior becomes positive

The most important factor in generating an action potential is: 4

a) Leak channels

b) Electrically gated channels

c) Chemically gated channels

d) The phospholipids of the cell membrane

e) The Na-K pump

Regarding the ascending limb of action potential curve :

S

A. K+ out flux takes place during this phase.

B. activation of voltage gated Na+ channels takes place.

C. the rate of Na+ movement increases after reaching a level of(-55 m.v)

D. both b & c are correct.

During the depolarization phase of the nerve action potential: 6

A. there is an increased influx of both K^+ and Na^+ ions.
B. there is an increased influx of Na^+ ions.
C. the membrane becomes more permeable to K^+ than Na^+ ions 100 time.
D. Leak Na^+ channels are activated.

Depolarization would lead to:

7

A. Net current in an outward direction
B. Cell interior becomes more negative
C. Cell interior becomes less negative
D. Cell exterior becomes more positive

During reversal of polarity

A. Cell exterior becomes positive due to presence of Na+ and K+.
B. Cell exterior becomes negative due to presence of protein and sulfate.
C. Cell interior becomes negative due to presence of protein and sulfate.
D. Cell interior becomes positive due to presence of Na+ and K+.

The first phase of the action potential, called the ……. phase and is produced through the opening of …….. : 9

A. Repolarization / voltage gated sodium channels
B. Depolarization / voltage gated sodium channels
C. Depolarization / ligand gated sodium channels
D. Depolarization / voltage gated potassium channels
E. Depolarization / ligand gated potassium channels

The firing level of a stimulated nerve fiber:

10

A. Is reached when the membrane potential changed by 15 m.v.
B. Is reached at the end of the spike potential.
C. Is reached by Na+-K + pump.
D. At which the permeability to K+ increases.

The firing level is equal :

a) (-70 m.v).

b) (-90 m.v).

c) (-55 m.v).

d) (zero m.v).

e) (+35 m.v).

Isopotential or zero potential means:

12

A. Repolarization
B. No potential difference between inside and outside
C. Cell interior becomes less negative
D. Cell exterior becomes more positive

Which of the following describes an "action potential"?

13

A. The high concentration of Na+ outside the cell and of K+ inside the cell

B. The permeability of membrane to K is 100 time than Na.

C. The opening of simple channels.

D. The movement of Na+ across the cell membrane into the cell, followed by the movement of K+ out of the cell.

When a nerve fibre is stimulated, depolarization phase stops at +35 mV. This is because:

14

A. Activation of the Na+-K + pump.
B. Activation of Na efflux.
C. Closing of the Na+ channels.
D. Closing of the K+ channels.

Repolarization is due to :

A. influx of K+

B. efflux of K+

C. influx of Na+

D. efflux of Na+

E. Influx of Ca^{2+}.

15

Repolarization of the membrane begins when:

16

A. Sodium channels are inactivated
B. Potassium channels close
C. Sodium entry slows down
D. Sodium channels are activated

Repolarization of an axon during an action potential is produced by

17

A. increasing of K^+ outflow.

B. increasing of K^+ inflow.

C. increasing of Na^+ outflow.

D. increasing of Na^+ inflow.

E. increasing of Ca^{+2} outflow.

The following is true about changes in cell membrane potential: LB

a) Repolarization is faster than depolarization

b) Repolarization takes longer than depolarization

c) firing level is at isopotential.

e) Na+ efflux is always the primary cause of repolarization

It is correct to say: 19

A. During RMP, the voltage gated Na+ channels are opened.

B. During early repolarization, the Na+ channels are opened.

C. During early repolarization, the Na+ channels are closed.

D. During depolarization, the Na+ channels are closed.

The after hyperpolalarization phase of the action potential is due to: 20

A. Openning of the Na^+ channels.
B. Closure of Na^+ channels.
C. K+ influx.
D. Slow return of the K^+ channels to the closed state.

The after depolarization phase of the action potential is due to: 21

a) is due to Na+ influx.

b) is due to K+ influx.

c) is due to slow K+ efflux.

d) is due to hyperactivity of Na+ K+ pump.

The …….. means outer surface becomes more positive than in resting condition.

a) Depolarization ٢٢

b) Isopotential

c) Reversal of polarity

d) After depolarization

e) After hyperpolarization

1. A
2. D
3. D
4. B
5. D
6. B
7. C
8. D
9. B
10. A
11. C
12. C+b
13. D
14. C
15. B
16. A
17. A
18. B
19. C
20. D
21. C 22. E